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UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
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# ADVANCE REPORT

## on the

# SEDIMENTATION SURVEY OF LAKE CALHOUN

# GALVA, ILLINOIS

**July 23 - August 6, 1936**

**by**

**Louis M. Glymph, Jr. and Victor H. Jones**

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**In Cooperation With**

**Illinois Agricultural Experiment Station**
**Urbana, Illinois**
**H. W. Mumford, Director**

**and**

**Illinois Department of Registration**
**Water Survey Division**
**Urbana, Illinois**
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**Sedimentation Studies**
**Division of Research**
**SCS-SS-16**
**May 1937**

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# GALVA, ILLINOIS

## GENERAL INFORMATION

Location: (fig. 1):

State: Illinois.

County: Knox, Secs. 14 and 23, T. 13 N., R. 4 E. (Lynn Township).

Distance and direction from nearest city: 5 miles southeast of Galva, Ill. on State Highway 93.

Drainage and backwater: Fitch Creek, a small stream flowing generally southward into Walnut Creek and thence into the Spoon River, a part of the Illinois River system.

Ownership: The Lake Calhoun Association, Inc., Galva, Ill.

Purpose served: Entirely recreational. Members of the Association own cottages and facilities for swimming, fishing, boating, and picnicking.

Description of dam: The dam is an earth-fill structure with a puddled core reinforced by a board wall. The core has a maximum width of 10 feet at its base, and the board wall extends through its center. The dam is 735 feet long, including the spillway at the west end. Its original height was 19 feet above the stream channel and the crest width was 12 feet. In 1929 the height of the dam was increased to 26 feet above the stream channel and the crest was widened to 24 feet to accomodate the 18-foot pavement and guard rails of State Highway 93, but the spillway was not changed. The present elevation of the dam crest is 728 feet. 1/ The slopes of the upstream and downstream faces are 3:1 and 2½:1, respectively.

The concrete spillway has an over-all length of 48 feet and a net crest length of 20 feet, the overflow passing through 4 rectangular notches 5 feet wide and 2½ feet deep (fig. 2 A). These openings are fitted with gates which may be closed to raise the water level 2½ feet. A wire-mesh fish screen rising

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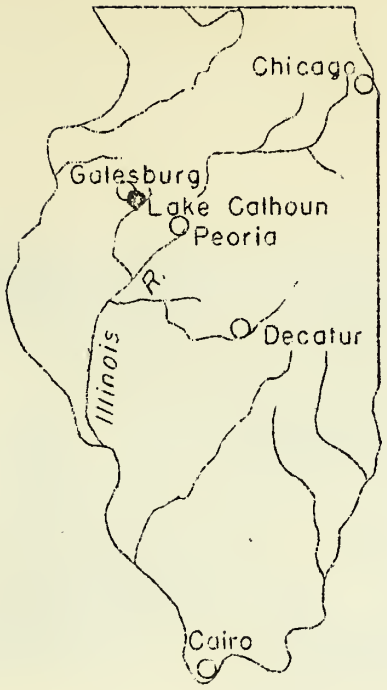
1/ Elevations are based on U. S. Geol. Survey datum.



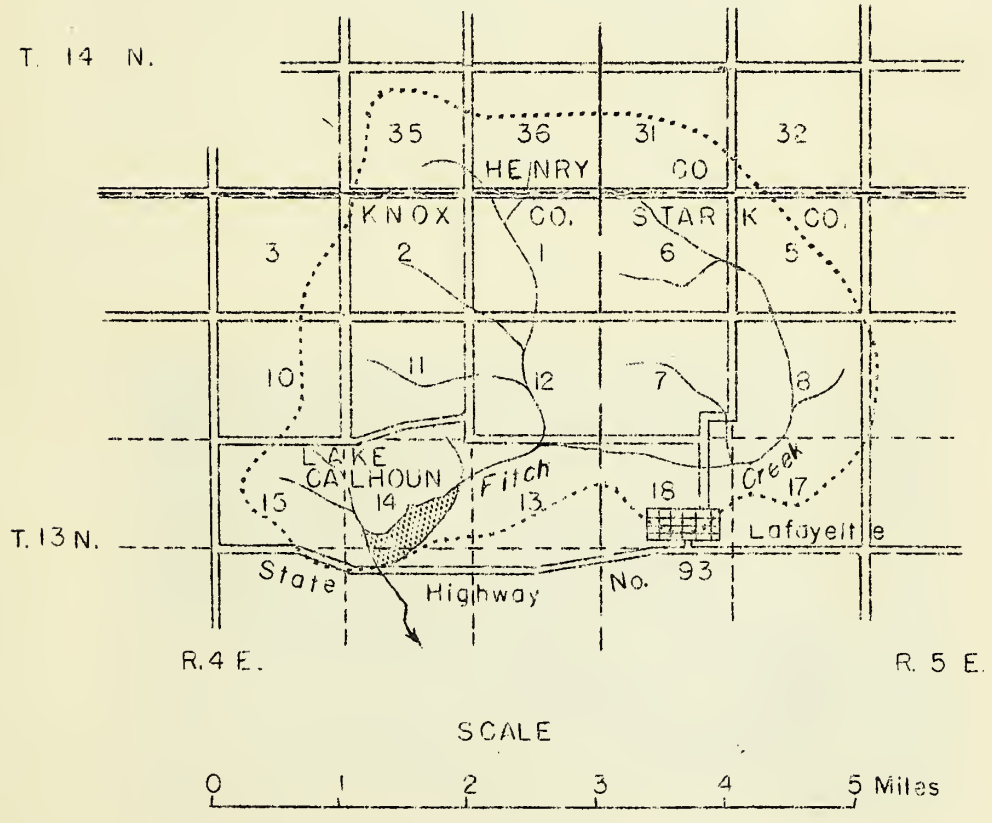
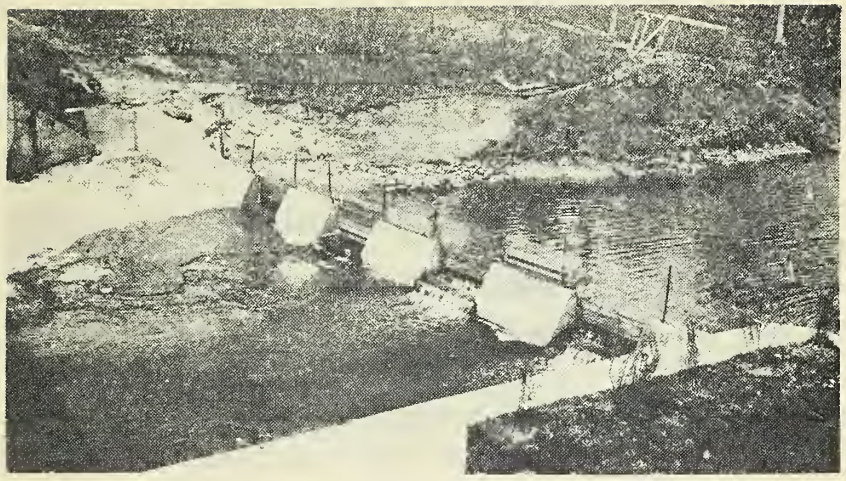
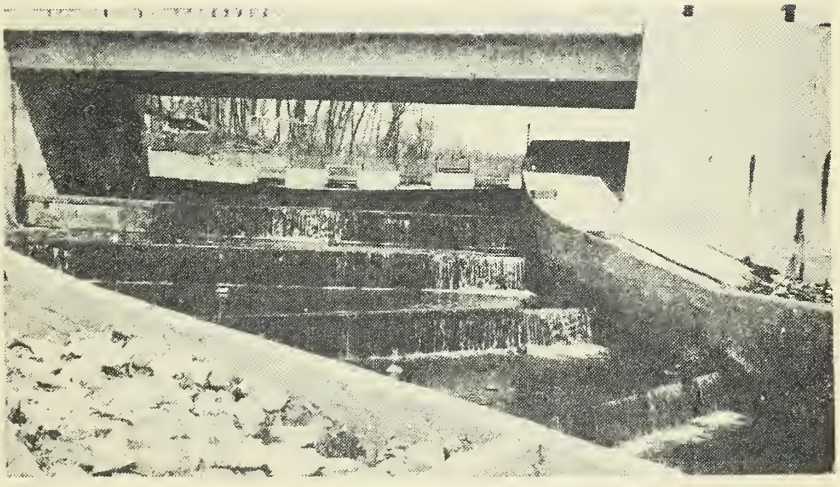




Fig. 1- Location and general relations of Lake Calhoun and its watershed.

Figure 2.



A. Upper end of spillway. Lake Calhoun.



B. Lower end of spillway. Lake Calhoun.

about 5 feet above the bottom of the openings extends the full length of the spillway. The effective crest level, at the bottom of the notches in the spillway, is 14 feet above the stream channel and 715.75 feet above mean sea level.

A concrete apron, joining the spillway a few inches below crest, extends with gentle slope 120 feet downstream and terminates in 5 steps, each 3 feet high and 10 feet wide, by which the overflow descends to the level of the channel below the dam (fig. 2 B).

Date of completion: Sept. 1, 1924.

Average date of survey: Aug. 1, 1936. Age: 11.9 years.

Length of lake:

| | Feet |
|---|---|
| Original | 3,275 |
| Present | 3,200 |
| Reduction | 75 |

These figures do not include the ponded channel of Fitch Creek, which at crest stage extends 3,900 feet from its junction with the lake proper to the head of backwater.

Area of lake at crest stage:

| | Acres |
|---|---|
| Original | 46.1 |
| Present | 44.3 |
| Reduction by sedimentation | 1.8 |

Storage capacity at crest stage:

| | Acre-feet | Gallons |
|---|---|---|
| Original | 286 | 93,193,100 |
| Present | 137 | 44,641,450 |
| Reduction by sedimentation | 149 | 48,551,650 |

General character of reservoir basin: Lake Calhoun is impounded in a small steep-sided valley floored with a well-developed flood plain about 600 feet wide. The length of the lake proper, from the dam to the extreme upper end, is 3,200 feet, and the greatest width is slightly less than 700 feet. (fig. 3 following p. 9 ). The greatest original depth near the dam was nearly 14 feet in the stream channel and 10 feet on the submerged flat. The average original gradient of the flood plain was therefore about 17 feet per mile.

A small tributary arm approximately 1,000 feet long and 400 feet wide at its lower end joins the main basin from the west about 800 feet above the dam. Fitch Creek does not enter the lake at the extreme upper end, but through a relatively recent channel along the left side of the valley at a point almost 1,000 feet nearer the dam. The average width of the channel is about 25 feet. The original channel was 4 feet below the level of the flood plain at the dam.

Area of watershed: 8,400 acres, or 13.1 square miles.

General character of watershed:

Geology.-- The entire watershed lies within the glaciated area of the Mississippi Valley plain, included in the Central Lowland province. No important outcrops of stratified rock formations are exposed in the watershed, which is covered everywhere by formations of two Pleistocene epochs. Table 1 indicates the stratigraphic relations, lithological composition, and degree of erosion of surface and near-surface formations.

Table 1.- Geologic formations of the Lake Calhoun watershed

| Age | Lithology | Thickness | Degree of erosion |
|---|---|---|---|
| | | Feet | |
| Pleistocene: | | | |
| Peorian..... | Loess..... | 15 | Extensively eroded. Covers nearly entire watershed. |
| Illinoian... | Gumbotil..... | 3 | Eroded on some slopes. Small outcrop area. |
| | Till..... | 30 | Eroded on most valley slopes. |
| Pennsylvanian | Sandstone, shale and coal..... | 333 plus | Not exposed. |

The loess is a powdery, soft eolian deposit consisting chiefly of silt-size particles which are highly angular and mineralogically heterogeneous. It is the parent material for a large percentage of the soils, and is characterized by a peculiar ability to maintain vertical faces as it undergoes gully erosion. The gumbotil[2/] is a highly plastic non-porous

2/ Kay, G. F., and Pearce, J. N. The Origin of Gumbotil. Jour. Geol. 28:89-125. 1920.

product of thorough leaching of the Illinoian till. It is agriculturally important where the loess cover is relatively thin, but its effect on sedimentation in Lake Calhoun is negligible.

Topography.-- The watershed as a whole is characterized by mature topography, which was developed on the gently undulatory surface of the Illinoian glacial till plain. The drainage pattern is typically dendritic and the watershed is roughly fan-shaped. Near the north edge of the watershed several points on the upland in Stark County approach an elevation of 850 feet above sea level, or 135 feet above crest level of the lake. The tributary valleys are short but numerous, and are V-shaped in cross section. Only Fitch Creek has developed a true valley flat, from which the valley walls rise steeply 50 to 60 feet to the level of the upland.

Soils.-- According to recent classification and mapping by the Soil Survey Division of the Illinois Agricultural Experiment Station, four principal soil types occur in the Lake Calhoun watershed.3/ The physical charcteristics and relative extent of these soils are given in the following table.

Table 2.- Soil types of the Lake Calhoun watershed

| Soil type | Description4/ | Area |
|---|---|---|
| | | Percent |
| Muscatine silt loam Type No. 41 | Dark brown silt loam developed under grass on undulatory topography. | 40 |
| Tama silt loam..... Type No. 36 | Light brown silt loam developed under grass on rolling topography. | 35 |
| Clinton silt loam.. Type No. 18 | Yellow-gray silt loam developed under forest on rolling topography. | 16 |
| Huntsville loam.... Type No. 73 | Variable from sand to silt and clay. Developed on river bottoms subject to periodical deposition. | 9 |
| | | 100 |

3/ Smith, R. S., Norton, E. A., Waschor, Herman, and Winters, Eric. Soil Survey Map of Stark County. Ill. Agr. Expt. Sta. 1933.

Hopkins, C. G., Mosier, J. G., Pettit, J. H., and Readheimer, J. E. Knox County Soils. Ill. Agr. Expt. Sta. Rept. no. 6. 1913.

Smith, R. S., DeTurk E. E., Bauer, F. C., and Smith, L. H. Henry County Soils. Ill. Agr. Expt. Sta. Rept. no. 41. 1928.

4/ Brief Descript of Stark County Soils (unpublished). Ill. Agr. Expt. Sta. December 1934.

The upland soils were all derived from the loess, and much of the bottomland soil material had a similar origin. The coarser sands and gravels in the channels were derived from till.

Erosion conditions.- Sheet erosion is moderate to severe in nearly the whole watershed, most of which is moderately to steeply sloping. Erosion is vigorous at the heads and along the bottoms of the small valleys and associated gullies. Only in the outer fringe of the drainage area, in a belt about one-half mile wide beyond the heads of the many small tributary valleys, is erosion less severe. It is estimated that in the watershed as a whole the rate of erosion is many times the geologic norm because of (1) removal of forests from the inner slopes of the larger valleys, (2) intensive grazing, and (3) erosion-inducing farming practices, particularly the cultivation of corn and other clean-tilled crops on sloping lands. Watersheds in the Illinoian drift region of western Illinois are peculiarly susceptible to any disturbance of the natural balance between erosion and growth of vegetative cover. The deep soft loess and loess-derived soils at the surface are speedily attacked by natural run-off, both sheet-like and in concentrated channels, when native trees and grass are removed.

Land Use.-- The Lake Calhoun watershed is a part of a large agricultural region in which corn is the principal crop and grazing is of considerable importance. The farms are productive and well equipped, and soil conservation practices are gradually being adopted. The following tabulation gives approximate percentages of land use in the watershed.[5/]

| Use | Percent |
|---|---|
| Cultivated land: | |
| Clean-tilled crops, chiefly corn..... | 33 |
| Oats, wheat, and soybeans..... | 15 |
| Rotation pasture and hay..... | 17 |
| Total..... | 65 |
| Permanent open pasture..... | 20 |
| Woodland pasture..... | 14 |
| Idle land..... | 1 |
| | 100 |

Mean annual rainfall: 33.11 inches, according to records of the U. S. Weather Bureau at Galva, Ill.

5/ Written communication from Julius R. Johnson, superintendent, Camp SCS-3, Galva, Illinois, Aug. 12, 1936.

Draft on reservoir: No water is withdrawn from the lake except a small quantity for private water-supply tanks at cottages.

## HISTORY OF SURVEY

The survey of Lake Calhoun was made by the Central Reservoir Party, Section of Sedimentation Studies, Division of Research, during the period July 23 to August 6, 1936. The personnel consisted of L. M. Glymph, Jr., chief of party, V. H. Jones, assistant chief, W. G. Shannon, H. L. Fischer, and O. D. Price.

Original and present storage capacities and silt volumes were determined by the range method of survey. 6/ During the survey 10 triangulation stations were established, approximately 4 miles of shore line were mapped, and 10 ranges were established, sounded, and spudded. The triangulation net was expanded from a 600-foot base line chained across the dam. As no suitable original map was available, the entire reservoir basin was remapped on a scale of 100 feet to the inch. All mapping was done with plane table and telescopic alidade. Triangulation stations, range ends, and cut-in stations were marked in the field by iron pipe stamped with the station numbers and set in concrete.

Under the terms of a cooperative project agreement with the Illinois Agricultural Experiment Station and the Water Survey Division, Illinois Department of Registration, the field party assisted in the collection of silt samples for analysis to determine plant food elements, texture, and colloid content. Eleven samples of bottom sediment were taken, the regular spud being used in submerged deposits and a 1½-inch soil auger in exposed deposits. Pint samples were taken in such a manner as to represent the entire silt thickness, and were preserved in airtight glass jars.

## ACKNOWLEDGMENTS

The Soil Conservation Service acknowledges the assistance given by local officials during the survey of Lake Calhoun. Information on the construction and history of the dam and lake was furnished by M. S. Morgan, engineer, of Galva, Ill. John Lovgren, secretary of the Lake Calhoun Association, also of Galva, assisted in securing boats and making arrangements for the survey and in furnishing concrete and pipe for the survey monuments. The figures pertaining to land use were supplied by Julius R. Johnson, superintendent of Camp SCS-3, Galva, Ill.

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6/ Eakin, H. M. Silting of Reservoirs. U. S. Dept. Agr. Tech. Bull. 524: 129-135. 1936.

## SEDIMENT DEPOSITS

Character of sediment.- The bulk of the sediment is dark blue-gray silt, which is so tenacious as to require the use of a brush in removing it from the silt sampler. The smoothness and tenacity of the silt indicate a considerable percentage of clay-size material and a substantial colloid content. Several zones of carbonaceous material were observed, especially near the bottom of the deepest silt accumulations. In these zones the original leaf strata had been almost completely altered to laminae of black carbonaceous clay. The lower part of the silt deposit, especially where its depth exceeds 2 feet, has acquired a noticeable degree of compaction.

Samples of bottom sediment for analysis were obtained at 11 points so distributed as to be representative of the reservoir. Analyses of the 11 samples are now being made in the laboratories of the Illinois Agricultural Experiment Station and the results will be incorporated in the final report on this investigation.

A relatively small percentage of the lake sediment consists of sand and gravel that has been shifted below crest by wave erosion and current action along the shores.

Distribution of sediment.- The sediment in Lake Calhoun, which has eliminated more than half of the original storage capacity, occurs in nearly uniform thickness in all parts of the reservoir, with minor exceptions. In the main body of the lake the depth of silt on the submerged flood plain is about 4 feet on range R1-R2, near the dam (fig. 3, following p. 9 ), and on the remaining 4 ranges (R3-R4, R10-R11, R12-R13, and R14-R15) the most common thickness is about 3 feet. On all ranges across the main lake the channel of Fitch Creek has been filled practically to the level of the silt-covered flood plain. On range R1-R2 the original stream channel had been filled artificially while the dam was under construction, but on ranges R3-R4, R10-R11, and R12-R13, approximately 9, 10, and 11 feet of silt, respectively, have been deposited in the old channel.

In the small bay above the point where Fitch Creek enters the lake proper, the depth of silt decreases from 6 feet on range R13-R14 to 1 foot at the crest line. A narrow strip of above-crest deposits extends along the east side and around the head of the bay (fig. 3, following p. 9 ).

In the tributary arm on the west side of the main lake silt depths range from 3 to 5 feet on the flood plain and from 7 to 10 feet in the submerged channel.

On ranges R13-R14, R16-R17, and R18-R19, across the ponded channel above the main lake, sediment filled the channel to depths of 5, 7, and 3 feet, respectively, at the time of survey, but is subject to seasonal scour and fill.

The relatively even distribution of sediment is the result of the uniformly fine texture of most of the incoming silt load. The bulk of this sediment is not dropped at once but is carried in suspension to all parts of the reservoir. Large quantities of suspended silt and clay are carried entirely through the lake and over the spillway, especially during flood periods.

Narrow sand and gravel shore zones have been developed along both shores of the main lake by wave and current action. The typical shore has a vertical wave-cut bank about 1 foot high with its base 2 feet above crest, a strip of ill-sorted sand and gravel between the bank and the crest line, and a 30-foot strip of sand just below crest level.

Origin of sediment.- It is estimated that more than 95 percent of the sediment in Lake Calhoun has been derived from loess and loessial soils. The remainder has originated chiefly from lateral cutting of steep glacial-till banks along the stream courses and to some extent from wave erosion along the lake shores. The sand and gravel deposits along the shore line are residual from wave and current erosion of glacial till.

Conclusions.- The situation at Lake Calhoun is illustrated by the following data: (1) a remaining storage capacity of only 10.4 acre-feet per square mile of drainage area, and (2) a high average rate of silt accumulation, amounting to more than 4 percent of the original capacity per year, which is equivalent to an annual loss of nearly 1 acre-foot per square mile of drainage area. These figures make it evident that, unless remedial measures are soon adopted, this reservoir will be completely silted in another 10 to 15 years. The cost of restoring depth and capacity by mechanical means, such as dredging, would probably be much greater per unit of volume than the original investment. Extensive and intensive application of erosion-control measures in the watershed would seem to be the only practical means of extending the life and usefulness of Lake Calhoun beyond a relatively few years. Such a program would have the double advantage of benefiting the lands of the watershed as well as the reservoir, and therefore from an economic standpoint should be doubly justifiable.

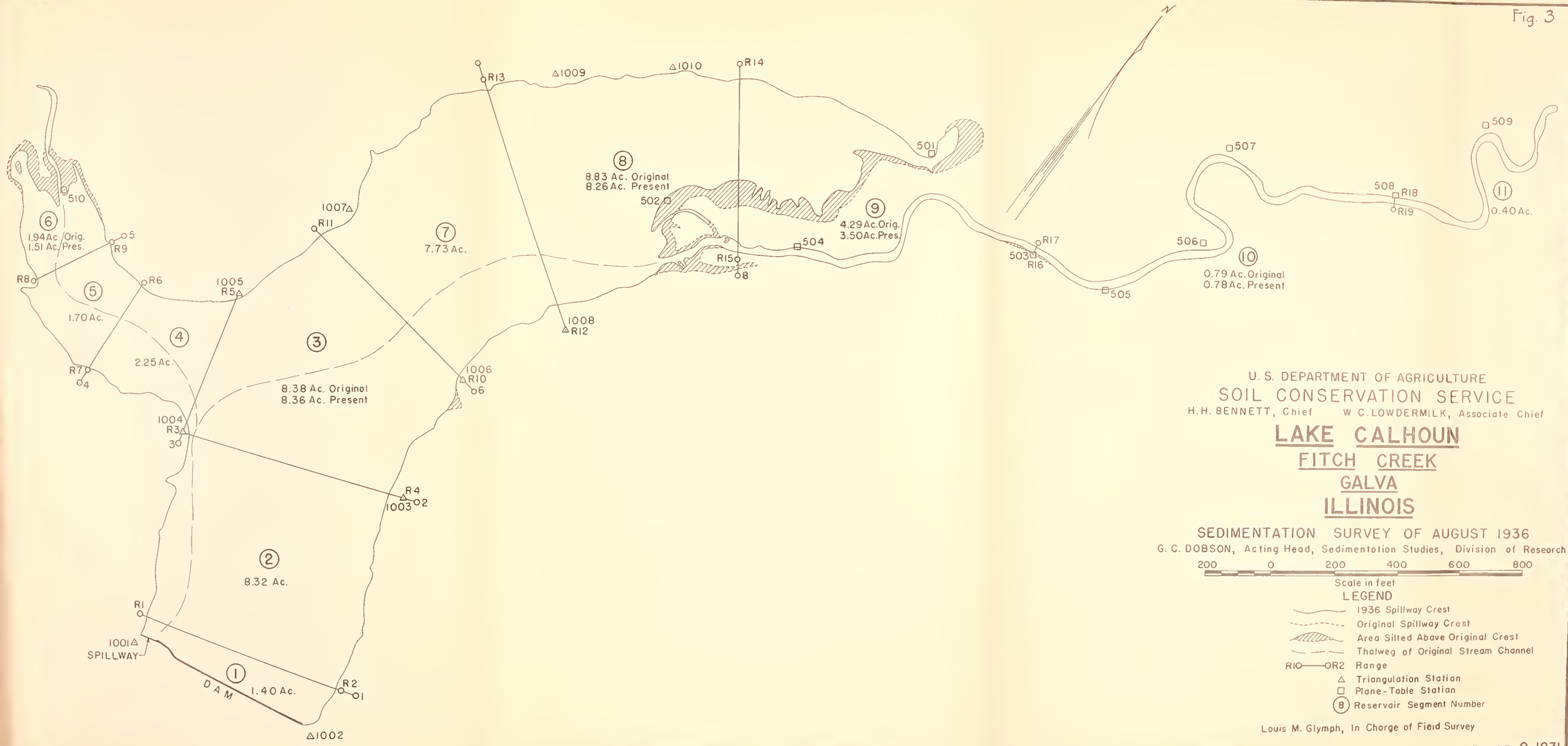
The findings of this survey indicate that Lake Calhoun has too large a watershed in relation to its storage capacity. Furthermore, it is located in a mature region of thorough drainage where highly erodible soils cover the surface, and where the removal of much of the natural vegetation has contributed to an increase in erosion to many times its normal rate. All these features should be avoided in selecting sites for reservoirs, unless adequate soil conservation measures in the watershed exist or are planned concurrently.

The following tabulation is a statistical summary of data relating to Lake Calhoun, Galva, Ill.

| | Quantity | Unit |
|---|---|---|
| Age: 1/ | 11.9 | Years |
| **Watershed:** | | |
| Total area | 13.1 | Square Miles |
| | 8,400 | Acres |
| **Reservoir:** | | |
| Original area at crest stage | 46.1 | Acres |
| Present area at crest stage | 44.3 | Acres |
| Original storage capacity | 286 | Acre-feet |
| Present storage capacity | 137 | Acre-feet |
| Original storage per square mile of drainage area | 21.83 | Acre-feet |
| Present storage per square mile of drainage area | 10.46 | Acre-feet |
| Original storage per acre of drainage area | 0.41 | Acre-inches |
| Present storage per acre of drainage area | 0.20 | Acre-inches |
| **Sedimentation:** | | |
| Delta deposits | Not measured separately | |
| Bottom-set beds | | |
| Total sediment | 149 | Acre-feet |
| Accumulation per year average | 12.5 | Acre-feet |
| Accumulation per year per 100 square miles drainage area | 95.4 | Acre-feet |
| Accumulation per year per acre of drainage area | 64.82 | Cubic feet |
| Or, assuming average weight of one cubic foot of silt is 100 pounds | 3.24 | Tons |
| **Depletion of storage:** | | |
| Loss of original capacity per year | 4.37 | Percent |
| Loss of original capacity to date of survey | 52.10 | Percent |

1/ Date storage began: Sept. 1, 1924.
Date of this survey: July 23 - Aug. 6, 1936.

Fig. 3




U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

H. H. BENNETT, Chief  W. C. LOWDERMILK, Associate Chief

# LAKE CALHOUN
## FITCH CREEK
## GALVA
## ILLINOIS

SEDIMENTATION SURVEY OF AUGUST 1936

G. C. DOBSON, Acting Head, Sedimentation Studies, Division of Research

200 0 200 400 600 800

Scale in feet

LEGEND

- 1936 Spillway Crest
- Original Spillway Crest
- Area Silted Above Original Crest
- Thalweg of Original Stream Channel
- R10—R2 Range
- △ Triangulation Station
- □ Plane-Table Station
- (8) Reservoir Segment Number

Louis M. Glymph, In Charge of Field Survey

3-4-37 0-1831